PARALLELOGRAM LAW OF VECTORS

Aim:
To find the weight of the given body using the parallelogram law of vectors.

Apparatus:
Parallelogram law apparatus, weight hangers, given body, slotted weights, sheet of paper, pins, etc.

Theory:
According to the parallelogram law of vectors, if two vectors are represented by the adjacent sides of a parallelogram, then the diagonal of the parallelogram represents their resultant.

Procedure:
A sheet of paper is fixed to the board using pins. Three strings are taken and knotted together at a point. The strings are then passed over pulleys. Weights are suspended from the free ends of two strings, while the given body is suspended from the third string. Suitable weights **P** and **Q** are added to the weight hangers so that the knot comes to equilibrium.

The positions of the strings are marked on the paper. The paper is then removed from the board, and the parallelogram is completed using a suitable scale. The diagonal is drawn, and its length is measured (OD).

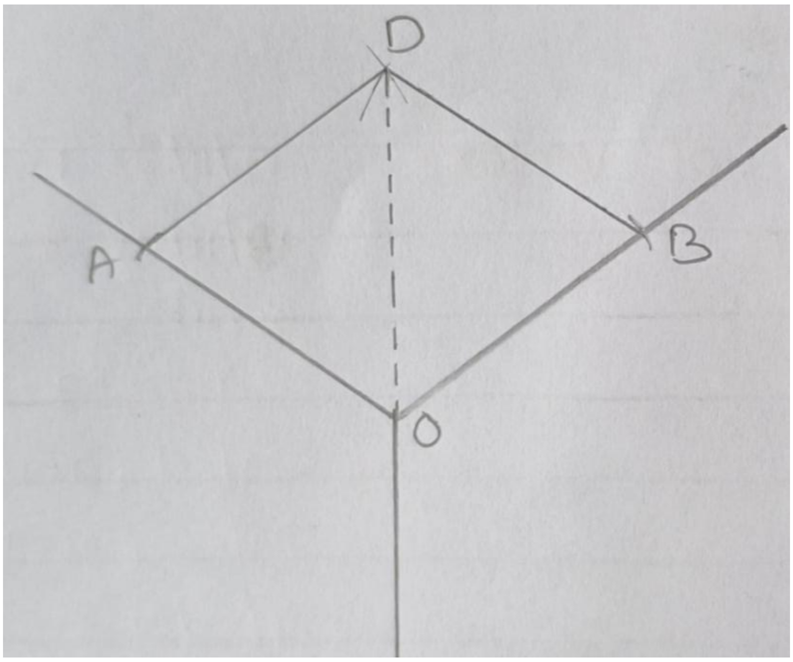
Weight of the body = OD × scale.

The experiment is repeated for different values of **P** and **Q**, and the average value is calculated.

Result

Weight of the given body =

Figure (Draw on left side of the book):



Observation Table (On the left side of book):

Scale factor = gwt

Trial No.	Forces (P) (gwt)	Forces (Q) (gwt)	Diagonal OD (cm)	Weight of the Body (OD × scale)	Mean Value (gwt)
1					
2					
3					

VERNIER CALIPERS

Aim:
To find the volume of the given sphere by measuring its diameter using Vernier calipers.

Apparatus:
Vernier calipers, given sphere.

Principle:

1.Least Count (L.C.) of Vernier Calipers $= \frac{\text{Value of one main scale division}}{\text{Number of Vernier scale divisions on the vernier scale}}$
2.Total Reading = (MSR)+(VSD×L.C.)
Where MSR - Main Scale Reading , VSD - Vernier Scale Division, LC- Least Count
3.Volume of the Sphere, V=$\frac{4}{3}\pi r^3$
where r- radius of sphere

Procedure:

The least count of the Vernier calipers is determined by noting the value of one main scale division and the number of divisions on the Vernier scale.

L.C.= $\frac{\text{1 msd}}{\text{n}}$
To measure the diameter of the sphere, it is placed between the jaws A and B of the Vernier calipers. The main scale reading (MSR) just before the zero of the Vernier scale and the Vernier scale division (VSR) coinciding with the main scale division are noted. The diameter of the sphere is calculated as:

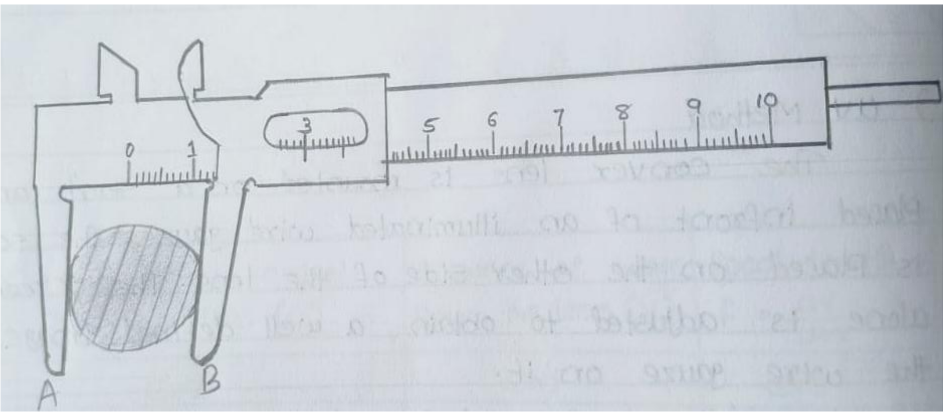
Diameter of the sphere = MSR+(VSD×L.C.)

The procedure is repeated by changing the position of the sphere, and the mean diameter is determined. From the mean diameter, the radius is obtained, and the volume of the sphere is calculated using:

V= $\frac{4}{3}\pi r^3$

Result:
The volume of the given sphere =

Figure (on left side)



Observations and calculations:

Magnitude of one main scale division, 1 msd =

Number of divisions on the vernier, n=

Least count (LC) = $\frac{1\ \mathrm{msd}}{\mathrm{n}}$

To find the diameter of the sphere (d):

Trial No.	Main Scale Reading (MSR)	Vernier Scale Division (VSD)	VSD × L.C.	Total Reading = MSR + (VSD × L.C.)	Mean Diameter (cm)
1					
2					
3					
4					
5					
6					

Radius of the sphere, r = $\frac{\mathrm{d}}{2}$

Volume of the sphere, V = $\frac{4}{3}\pi r^3$

Simple Pendulum

Aim:
To determine the acceleration due to gravity at a given place using a simple pendulum.

Apparatus:
Simple pendulum, stopwatch, meter scale, wooden block, cork, etc.

Principle:

The time period T of a simple pendulum is given by:

$T=2\pi\sqrt{\frac{l}{g}}$

Rearranging,

$g= 4\pi^2 \frac{l}{T^2}$

where l is the length of the pendulum and g is the acceleration due to gravity. Here, the time period is the time taken to complete one oscillation.

Procedure:

The diameter of the bob is determined using a wooden block. The bob is tied to one end of the string, and the other end of the string is passed through the cork. The length of the pendulum is adjusted to 50 cm. (Note: The length of the pendulum is measured from the center of the bob to the point of suspension.) The pendulum is displaced slightly and released so that it oscillates freely. The time taken for 20 oscillations is measured using a stopwatch. The experiment is repeated, and the average time for 20 oscillations is calculated. The time period (T) is obtained by dividing the time by 20. $\frac{l}{T^2}$ is calculated. The experiment is repeated for different lengths of the pendulum, and the average value of $\frac{l}{T^2}$ is calculated.

The value of g is then calculated using the formula:

$$g = \frac{4\pi^2 l}{T^2}$$

Result:
The acceleration due to gravity at the place =

Observations and calculations:

Trial No	Distance from top of bob to bottom of cork	Length of the pendulum	Time for 20 oscillations			Period	T^2	l/T^2
	$l-r$ (cm)	l (cm)	1	2	Mean t (s)	$T=t/20$ (s)	(s^2)	(cm/s^2)
1								
2								
3								
4								
5								
6								

Mean $\frac{l}{T^2}$ =

g = $\frac{4\pi^2 l}{T^2}$

Screw Gauge

Aim:
To determine the diameter of a given wire using a screw gauge and hence calculate its volume.

Apparatus:
Screw gauge, given wire.

Principle:
The least count (LC) of the screw gauge is the distance through which the screw advances when it is rotated through one division of the head scale.

1.Pitch of the screw = $\frac{Distance\ moved}{No\ of\ rotations}$

2.Least Count (LC) $= \frac{Pitch}{No\ of\ divisions\ on\ the\ head\ scale}$

where pitch of the of the screw is the distance through which the screw advances in one complete rotation of the head scale.

3.Total reading = PSR + (corrected HSR x LC)

Where PSR - pitch scale reading,

HSR – head scale reading

and LC – least count.

4.Volume of the wire, V = $\pi r^2 l$

Where r is the radius of the wire,

l is the length of the wire

Procedure:

To determine pitch and least count of the screw gauge:
The pitch is the distance moved by the screw for one complete rotation of the head scale. To find the pitch, an even number of complete rotations (say 10) are given to the head of the screw, and the distance moved is noted on the pitch scale. Dividing the distance by the number of rotations gives the pitch.

Pitch of the screw = $\frac{Distance\ moved}{No\ of\ rotations}$

Least Count (LC) $= \frac{Pitch}{No\ of\ divisions\ on\ the\ head\ scale}$

To find the zero correction
The plane faces of the stud and tip are made to touch each other. If the zero of the head scale coincides with the reference line on the pitch scale, there is no zero correction. If the zero reading on

the head scale is below the reference line, the zero correction is negative. If the zero reading on the head scale is above the reference line, the zero correction is positive.

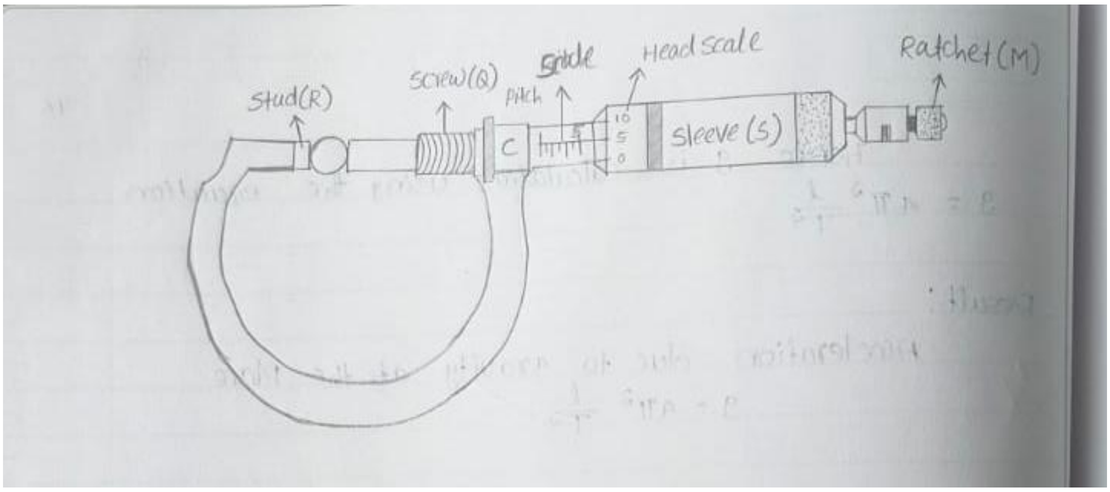
To find the diameter of the wire

The given wire is gently pressed between P and Q by rotating the screw forward. The pitch scale reading (PSR) immediately before the reference line is noted. The head scale reading (HSR) coinciding with the line of the pitch scale is also noted. The zero correction is then added to the observed reading, to get the corrected reading. The pitch scale reading is then added to the corrected HSR (multiplied with LC) which gives the diameter. The experiment is repeated.

Result :

Volume of the given wire =

Figure (on left side)



Observations and Calculations

Magnitude of a pitch scale division = ...
Distance moved for 10 rotations = ...
Pitch of the screw, p = s / n = ...

No. of divisions on the head scale, N = ...

Least count, LC = p / N = ... mm
Zero correction, Z = ... div = ... mm

To find the diameter of the wire:

Trial No.	PSR (Pitch Scale Reading)	Observed HSR	Corrected HSR	Corrected HSR*LC	Total reading = PSR + (Corrected HSR*LC)
	(mm)	(div)	(mm)	(mm)	(mm)
1					
2					
3					
4					
5					
6					

Mean diameter of the wire (d) =

Radius of the wire (r) = d/2

Length of the wire (l) =

Volume of the wire, V = $\pi r^2 l$

Moment bar

Aim:

To find the mass of the given body.

Apparatus:

Meter scale, slotted weight, string, stand, given body.

Principle:

When a uniform bar remains horizontal, the clockwise moment equals the anticlockwise moment.

$$M * AG = W * BG$$

$$M = \frac{W * BG}{AG}$$

This is the working formula.

Procedure:

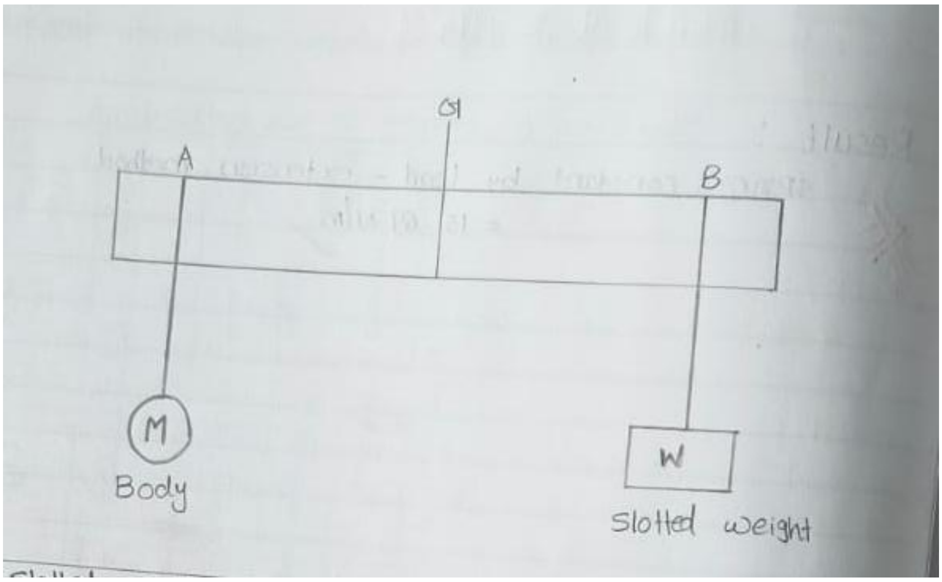
The given meter scale is suspended from a string through the centre of gravity so that the scale is horizontal. The given body is suspended from the scale at A. The slotted weight (W) is suspended from the other side of the scale at B. The weight is adjusted so that the scale remains horizontal. Let its position be at B. Measure AG and BG in each case. The experiment is repeated by changing the slotted weight. Keep AG constant, and BG is measured in each case. Readings are tabulated, and the mass of the body can be calculated using the equation

$$M = \frac{W * BG}{AG}$$

Result:

Mass of the given body =

Figure



Observations and calculations:

Trial No.	**Slotted Weight (W) (g)**	**AG (cm)**	**BG (cm)**	M= $\frac{W*BG}{AG}$ (g)	Mean g
1					
2					
3					
4					
5					
6					